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Huang et al.

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(54) **CHARGING DEVICE**

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H02J 7/02 (2016.01)
H02J 9/00 (2006.01)

(52) **U.S. Cl.**
CPC ***H02J 7/02*** (2013.01); ***H02J 7/0042*** (2013.01); *H02J 7/0031* (2013.01); *H02J 9/005* (2013.01)

(58) **Field of Classification Search**
USPC 320/107, 112, 114
See application file for complete search history.

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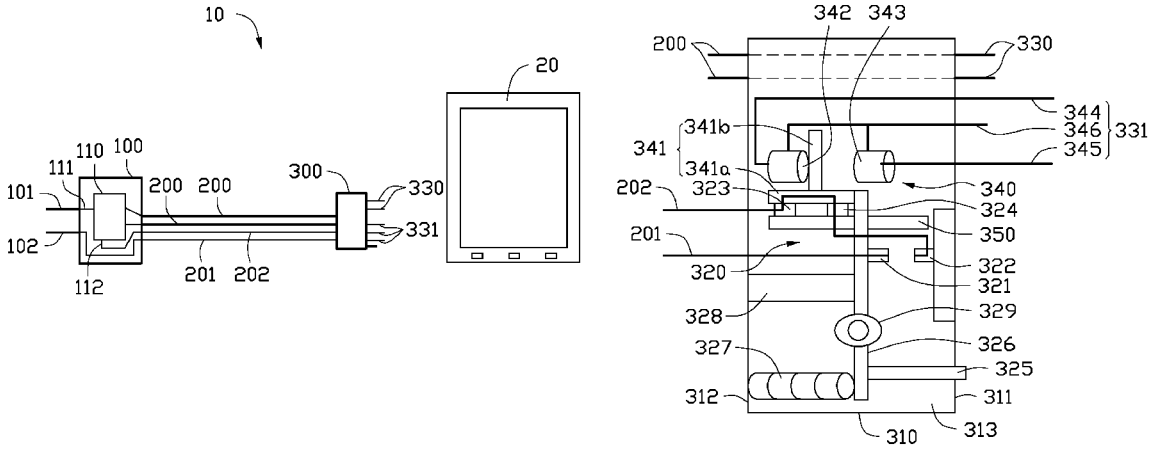
(57) **ABSTRACT**

A charging device includes a power converting unit and a power output unit. The power converting unit comprises a first conductive pin, a second conductive pin, and a converter. The first conductive pin and the second conductive pin are electrically connected to an alternating current (AC) power. The converter converts the AC power to a direct current (DC) power and outputs the DC power. The power output unit is electrically connected to the converter via a number of cables, and outputs the DC power to an electronic device. The power output unit comprises a first switch and a second switch. When the electronic device separates from the power output unit, the first switch controls the converter to stop receiving the AC power. When the electronic device is completely charged, the second switch controls the converter to stop receiving the AC power.

18 Claims, 8 Drawing Sheets



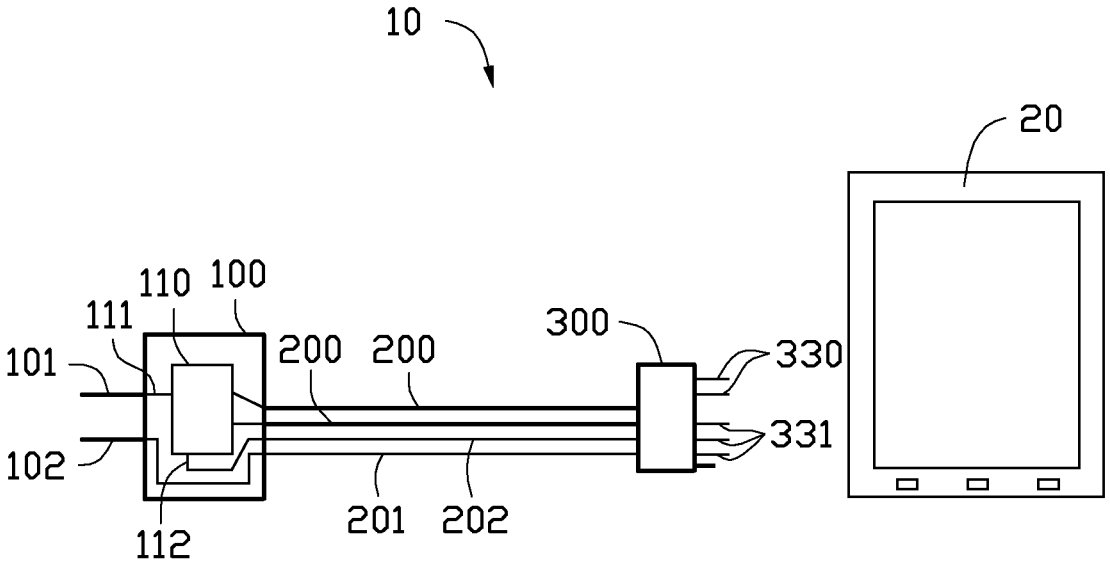
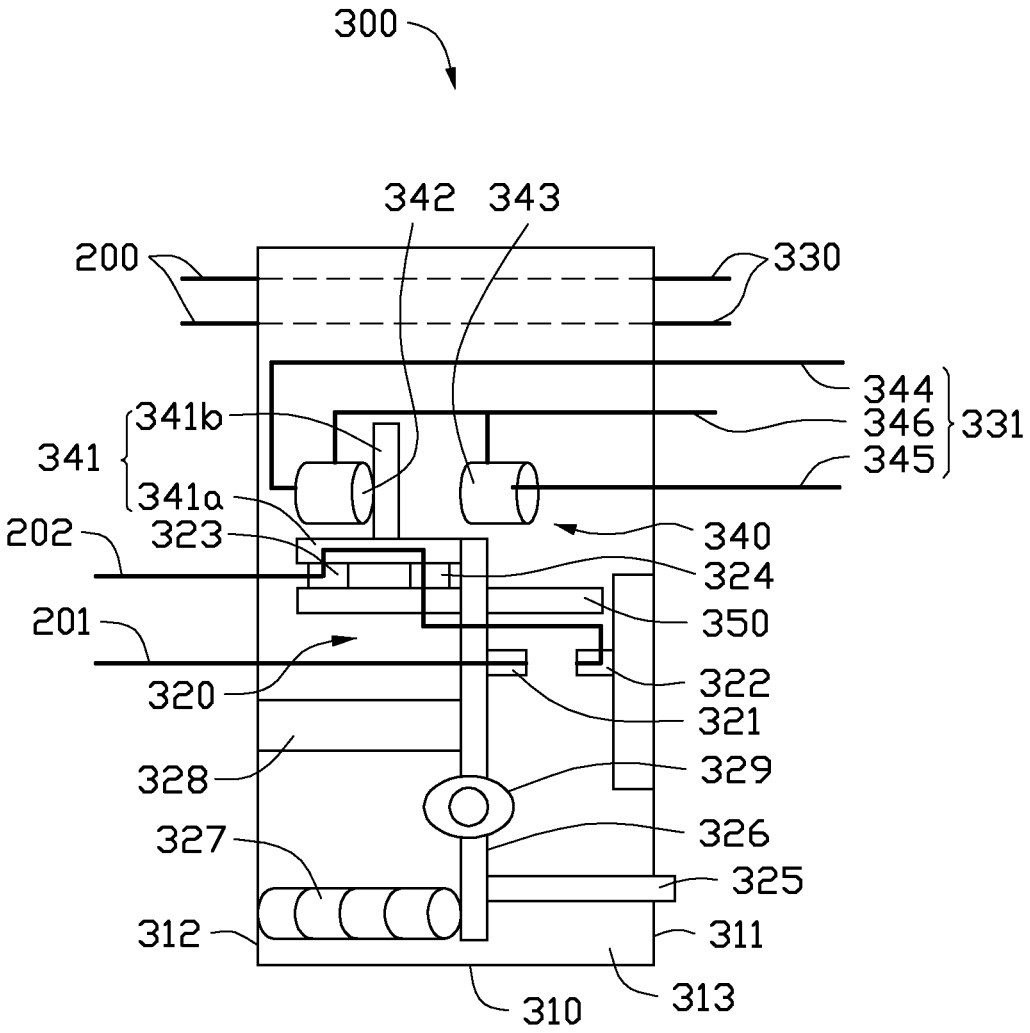


FIG. 1


300
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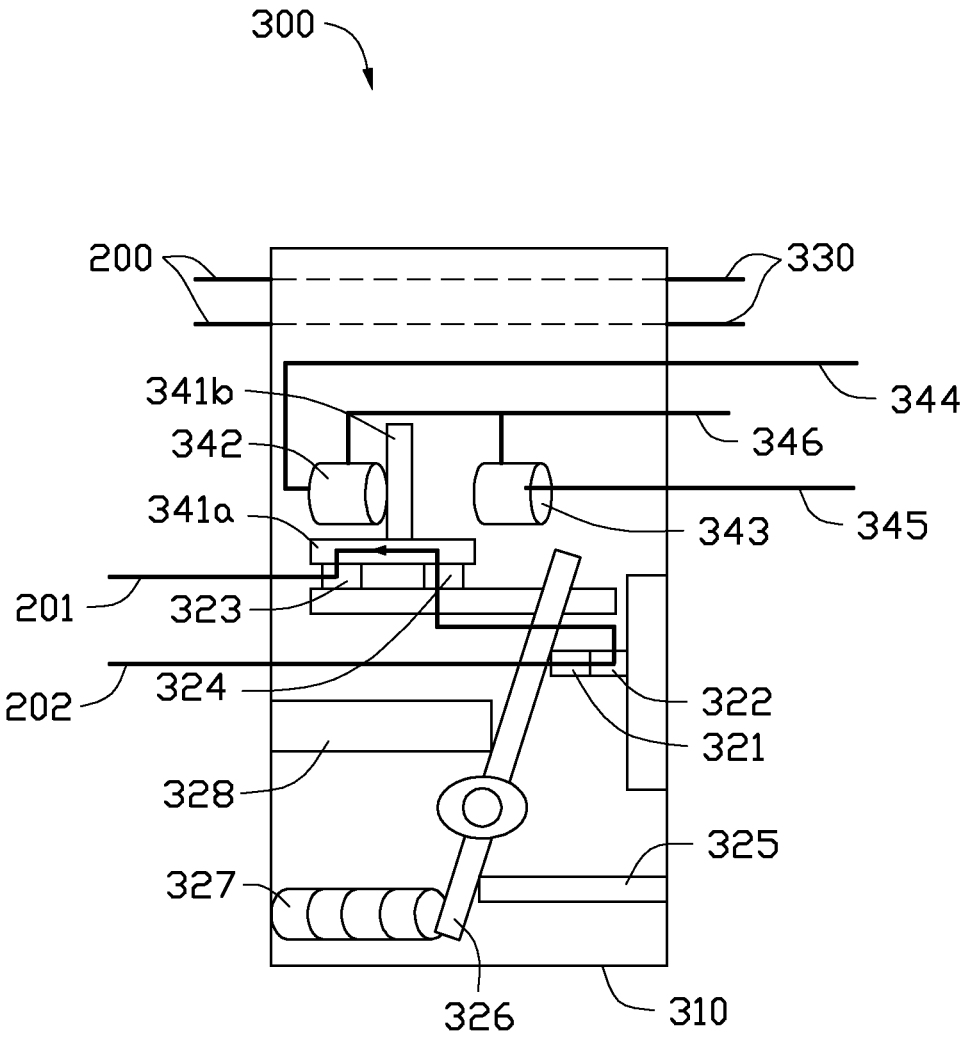
310

FIG. 2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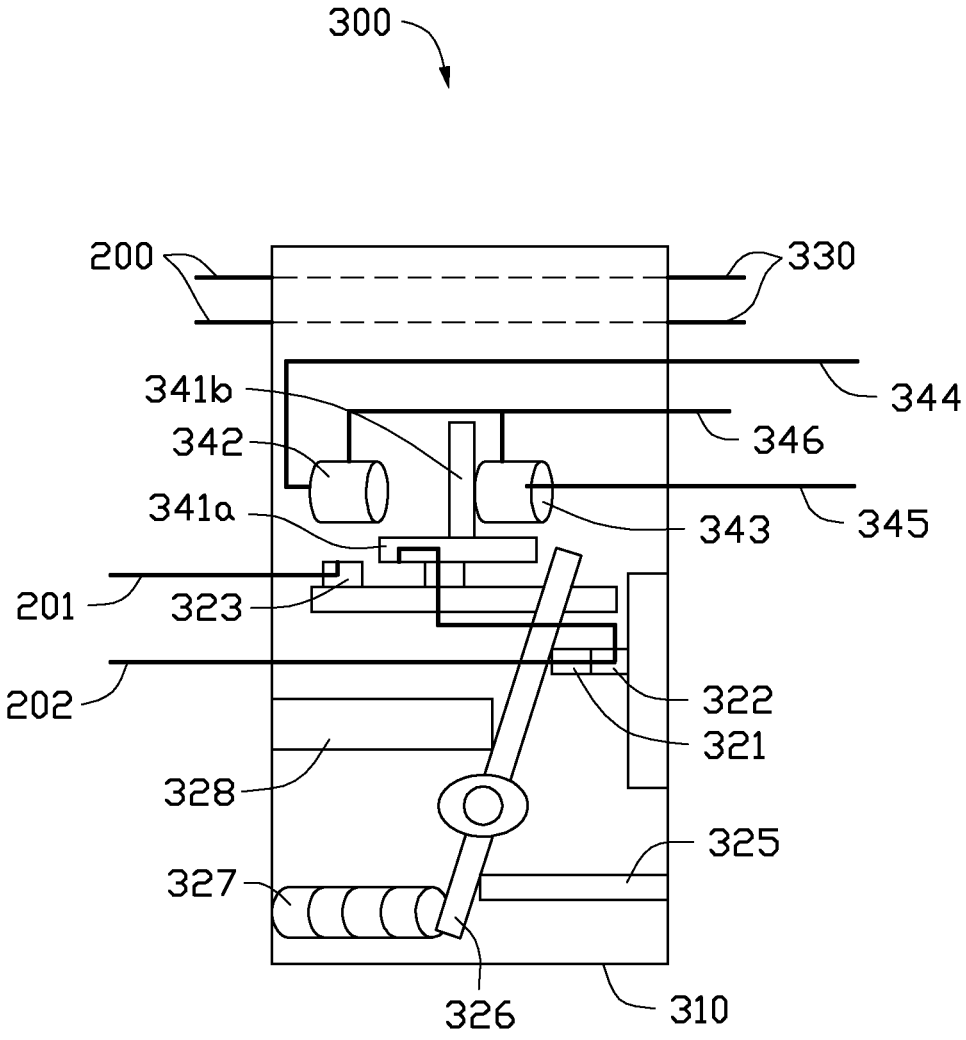
310

FIG. 3


300
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341a
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201
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202
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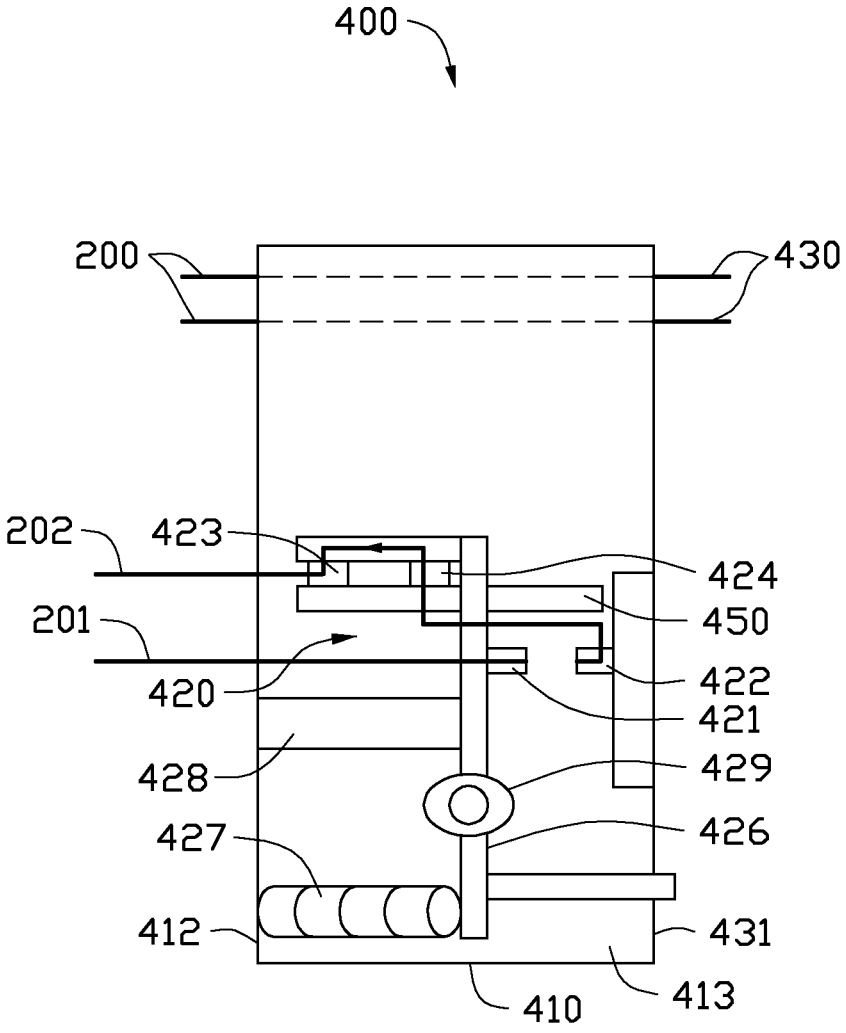
325
327
326
310

FIG. 4


400
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430
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423
424
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FIG. 5

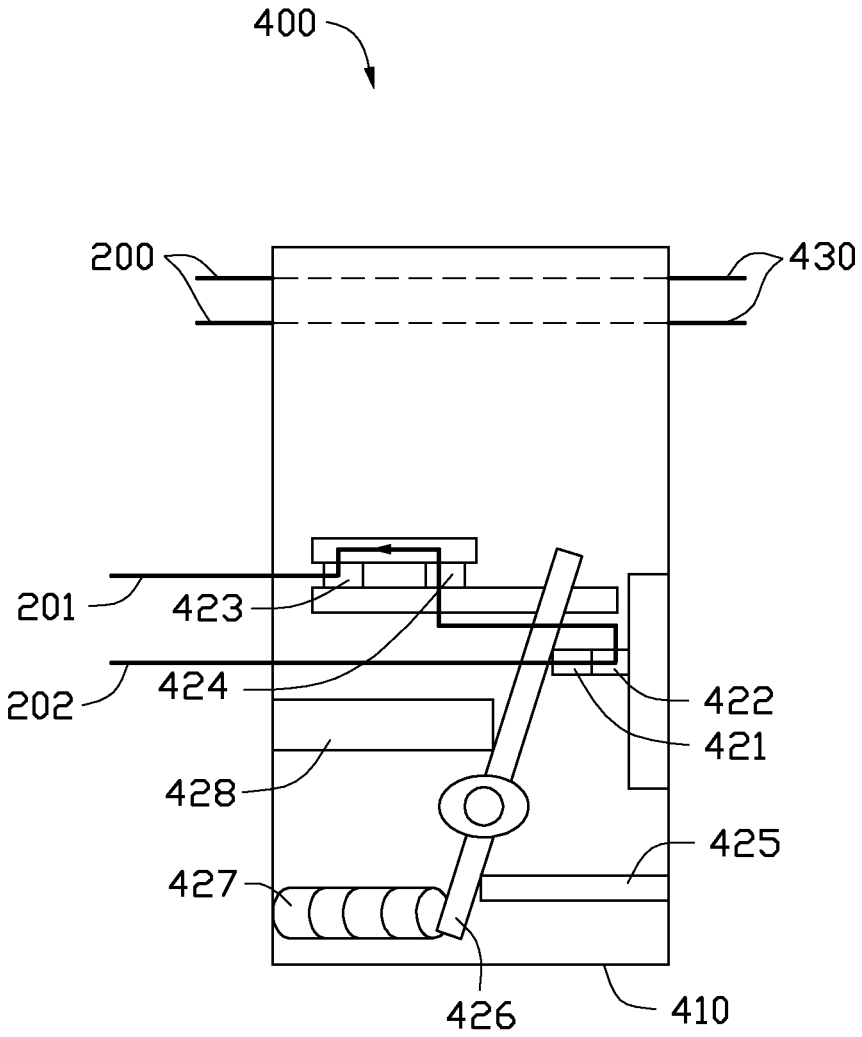
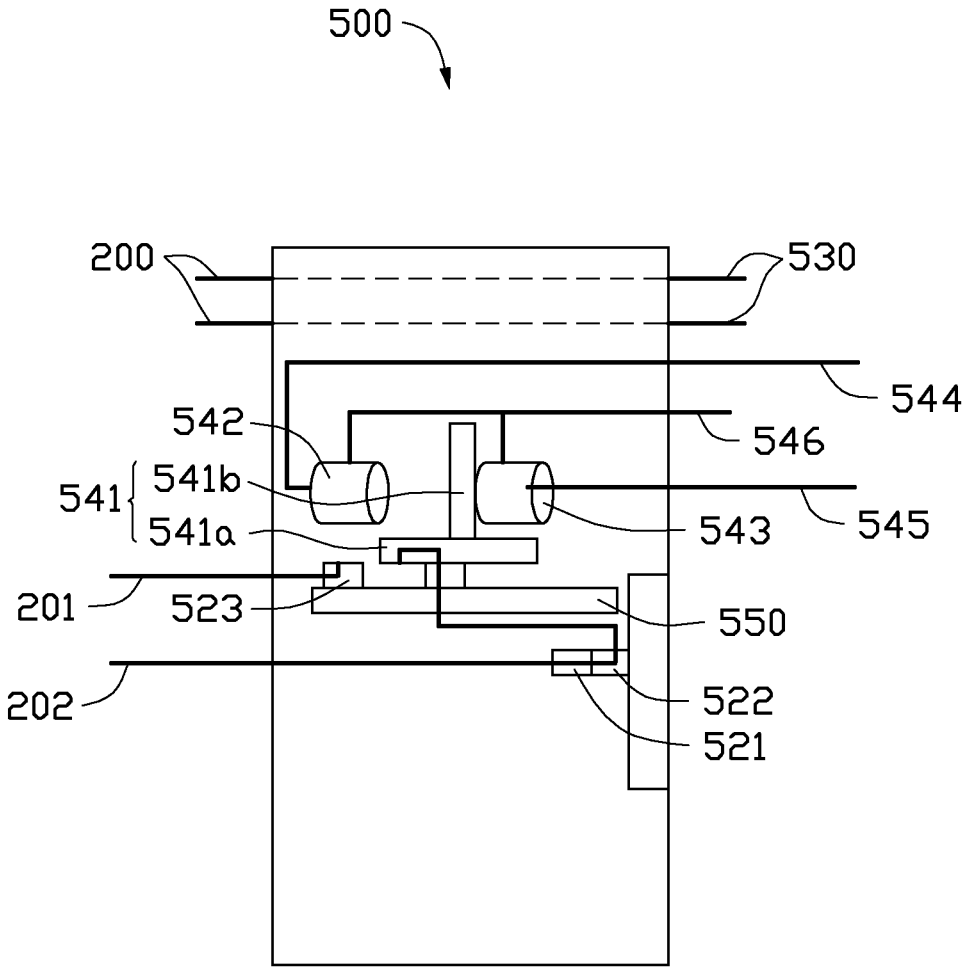


FIG. 6


500
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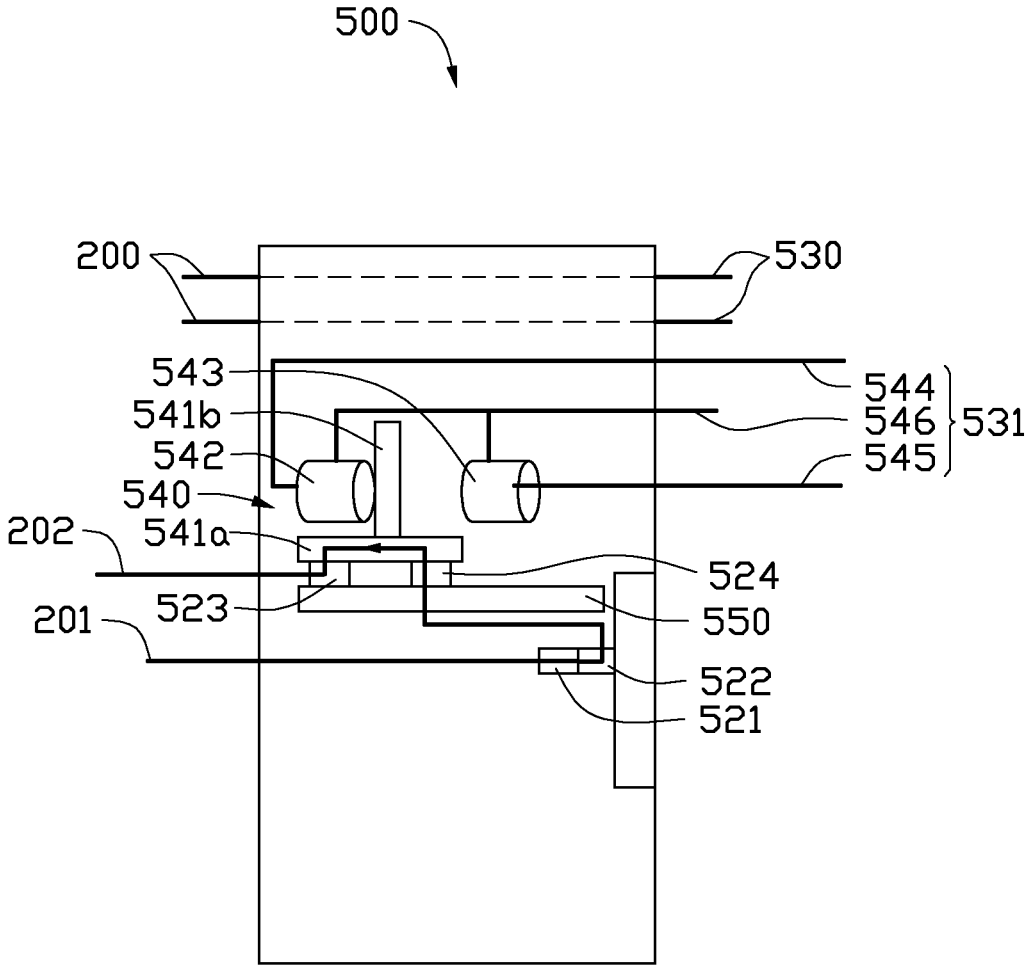
530
544
542
546
541
541b
541a
543
545
201
523
550
202
522
521

FIG. 7


500
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544
541b
546
531
542
545
540
202
541a
524
523
550
201
522
521

FIG. 8

CHARGING DEVICE

BACKGROUND

1. Technical Field

The present disclosure relates to a charging device.

2. Description of Related Art

Portable electronic devices, such as mobile phones, often have rechargeable batteries for providing operation voltages to the electrical components. Usually, a portable electronic device is connected to a charging device via a power line and a connector to charge the battery. However, when the electronic device is removed from the charging device, if the charging device is still electrically connected to an alternating current (AC) power source, the charging device may keep consuming power, which is wasteful.

Therefore, what is needed is a means to overcome the above-described shortcoming.

BRIEF DESCRIPTION OF THE DRAWINGS

The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of at least one embodiment. In the drawings, like reference numerals designate corresponding parts throughout the various views.

FIG. **1** is a schematic view of a first embodiment of a charging device having a power output unit.

FIG. **2** is a schematic diagram of an internal structure of the power output unit of the charging device of FIG. **1**.

FIG. **3** is a schematic diagram of the internal structure of the power output unit of FIG. **1** electrically connecting to an electronic device.

FIG. **4** is a schematic diagram of the internal structure of the power output unit of FIG. **1** after being fully charged.

FIG. **5** is a schematic diagram of a second embodiment of an internal structure of a power output unit of a charging device disconnected from an electronic device.

FIG. **6** is a schematic diagram of the internal structure of the power output unit of the charging device of FIG. **5** in a state of being charged.

FIG. **7** is a schematic diagram of a third embodiment of an internal structure of a power output unit of a charging device disconnected from an electronic device.

FIG. **8** is a schematic diagram of the internal structure of the power output unit of the charging device of FIG. **7** in a state of being charged.

DETAILED DESCRIPTION

The disclosure is illustrated by way of example and not by way of limitation in the figures of the accompanying drawings in which like references indicate similar elements. It should be noted that references to "an" or "one" embodiment in this disclosure are not necessarily to the same embodiment, and such references mean "at least one." The references "a plurality of" and "a number of" mean "at least two."

Reference will be made to the drawings to describe various embodiments.

FIG. **1** shows an embodiment of a charging device **10**. The charging device **10** includes a power converting unit **100**, a power output unit **300**, and a plurality of cables **200** connected between the power converting unit **100** and the power output unit **300**. The power converting unit **100** converts an alternating current (AC) power from an external power source to a direct current (DC) power, and outputs the DC power to the power output unit **300** via the plurality of cables **200**. The power output unit **300** is configured to electrically connect to an electronic device **20**. The power output unit **300** outputs the DC power to the electronic device **20** to charge the electronic device **20**. The electronic device **20** can be, but is not limited to, a smart phone, a mobile Internet device (MID), or other similar device.

The power converting unit **100** includes a first conductive pin **101**, a second conductive pin **102**, and a converter **110**. The first conductive pin **101** and the second conductive pin **102** are electrically connected to the AC power. The first conductive pin **101** is electrically connected to the converter **110**. The second conductive pin **102** is electrically connected to the power output unit **300** via a first cable **201**. The converter **110** includes a first input terminal **111** and a second input terminal **112**. The first input terminal **111** is electrically connected to the first conductive pin **101**. The second input terminal **112** is electrically connected to the power output unit **300** via a second cable **202**. The second input terminal **112** is selectively electrically connected to or disconnected from the second conductive pin **102** under control of the power output unit **300**. The converter **110** is electrically connected to the power output unit **300** via the plurality of cables **200**.

FIG. **2** shows a schematic diagram of an internal structure of the power output unit **300**. The power output unit **300** includes a shell **310**, a plurality of electrical pins **330**, and a detection control portion **331**. The shell **310** defines a receiving space to receive the plurality of electrical pins **330** and the detection control portion **331**. The shell **310** includes a first side surface **311**, a second surface **312** opposite from the first side surface **311**, and a third side surface **313** located between the first side surface **311** and the second surface **312**. The plurality of electrical pins **330** and the detection control portion **331** protrude out of the first side surface **311** to connect to the electronic device **20**. The plurality of electrical pins **330** are electrically connected to the converter **110** via the plurality of cables **200**. The detection control portion **331** detects whether the power output unit **300** is electrically connected to or disconnected from the electronic device **20** and whether the electronic device **20** is fully charged.

The power output unit **300** further includes a first switch **320** and a second switch **340** received in the receiving space of the shell **310**. When the power output unit **300** is electrically connected to the electronic device **20**, the first switch **320** is turned on. When the power output unit **300** is disconnected from the electronic device **20**, the first switch **320** is turned off. When the electronic device **20** is fully charged, the second switch **340** controls the first cable **201** to disconnect from the second cable **202**. When the electronic device **20** is being charged, the second switch **340** controls the first cable **201** to connect to the second cable **202**.

The first switch **320** includes a first connection terminal **321**, a second connection terminal **322**, a third connection terminal **323**, a fourth connection terminal **324**, a detection bar **325**, a rotation bar **326**, an elastic member **327**, a supporting portion **328**, a pivot **329**, and a platform **350**. The platform **350** is located at a substantially middle portion of the third side surface **313**.

The first connection terminal **321** is fixed on one end portion of the rotation bar **326** and electrically connected to the second conductive pin **102** via the first cable **201**. The second connection terminal **322** is aligned with the first connection terminal **321** and fixed on the first side surface **311**. The third connection terminal **323** is fixed on the platform **350** and adjacent to the second side surface **312**. The third connection terminal **323** is electrically connected to the second input terminal **112** via the second cable **202**. The fourth connection terminal **324** is fixed on the platform **350** and located adjacent

to the third connection terminal **323**. In one embodiment, the third connection terminal **323** and the fourth connection terminal **324** are located on a same surface of the platform **350**, and the fourth connection terminal **324** is electrically connected to the second connection terminal **322** via the second cable **202**.

The rotation bar **326** rotates about the pivot **329**. A first end of the rotation bar **326** is connected to the second side surface **312** via the elastic member **327**, and a second end of the rotation bar **326** extends toward the fourth connection terminal **324**.

A first end of the detection bar **325** protrudes out of the first side surface **311**, and a second end of the detection bar **325** resists against the first end of the rotation bar **326**. The detection bar **325** and the elastic member **327** are located on two opposite sides of the rotation bar **326**, respectively, and are substantially perpendicular to the rotation bar **326**. When the electronic device **20** is electrically connected to the power output unit **300**, the detection bar **325** is pushed into the shell **310** by the electronic device **20**, thereby rotating the rotation bar **326** and compressing the elastic member **327**. When the electronic device **20** is disconnected from the power output unit **300**, the elastic member **327** rebounds to push the first end of the detection bar **325** out of the shell **310**.

The supporting portion **328** is located on the second side surface **312** to limit a rotation angle of the rotation bar **326**.

The second switch **340** includes a substantially T-shaped portion **341**, a first electromagnetic portion **342**, and a second electromagnetic portion **343**. The first electromagnetic portion **342** and the second electromagnetic portion **343** are arranged in the shell **310**. When a current flows through the first electromagnetic portion **342** and the second electromagnetic portion **343**, the first electromagnetic portion **342** and the second electromagnetic portion **343** are magnetized and attract the T-shaped portion **341**.

The T-shaped portion **341** includes a sliding member **341***a* and an attracting member **341***b*. The sliding member **341***a* is slidably connected to the platform **350**. The attracting member **341***b* is located between the first electromagnetic portion **342** and the second electromagnetic portion **343**. The attracting member **341***b* is capable of sliding along with the sliding member **341***a*. The sliding member **341***a* is located on and electrically connected between the third connection terminal **323** and the fourth connection terminal **324**.

In the embodiment, the sliding portion **341***a* is a conductive element. When the attracting member **341***b* is attracted by the first electromagnetic portion **342**, the sliding portion **341***a* contacts both the third connection terminal **323** and the fourth connection terminal **324**, thereby electrically connecting the third connection terminal **323** to the fourth connection terminal **324**. When the attracting member **341***b* is attracted by the second electromagnetic portion **343**, the sliding portion **341***b* slides past the third connection terminal **323**, thereby cutting off the electrical connection between the third connection terminal **323** and the fourth connection terminal **324**.

In another embodiment, the sliding member **341***a* is directly fixed on the fourth connection terminal **324**, and the fourth connection terminal **324** is slidable along the platform **350**. The sliding member **341***a* is electrically connected to the third connection terminal **323** or disconnected from the third connection terminal **323** when the fourth connection terminal **324** slides along the platform **350**.

The detection control portion **331** includes a first control terminal **344**, a second control terminal **345**, and a third control terminal **346**. The first control terminal **344** and the second control terminal **345** are electrically connected to the first electromagnetic portion **342** and the second electromagnetic portion **343**, respectively. The third control terminal **346** is electrically connected to both the first electromagnetic portion **342** and the second electromagnetic portion **343**.

FIGS. **2-4** show different states of the electronic device **20**. Referring to FIG. **2**, when the charging device **10** is disconnected from the electronic device **20**, the rotation bar **326** is substantially perpendicular to the third side surface **313**, the elastic member **327** is not compressed, the first connection terminal **321** is disconnected from the second connection terminal **322**, and the sliding member **341***a* is electrically connected between the third connection terminal **323** and the fourth connection terminal **324**.

When the first connection terminal **321** is disconnected from the second connection terminal **322**, the second input terminal **112** is disconnected from the second conductive pin **102**. At this time, the second connection terminal **322**, the first connection terminal **321**, the first cable **201**, and the converter **110** stop working.

Referring to FIG. **3**, when the charging device **10** charges the electronic device **20**, the detection bar **325** is pushed into the shell **310** by the electronic device **20**. The detection bar **325** pushes the rotation bar **326** to rotate about the pivot **329**, and the elastic member **327** is compressed. The rotation bar **326** drives the first connection terminal **321** to electrically connect to the second connection terminal **322**. The first control terminal **344** receives a logic high signal (e.g. logic "1"), the second control terminal **345** receives a logic low signal (e.g. logic "0"), and a current flows through the first electromagnetic portion **342**. Under this condition, the first electromagnetic portion **342** attracts the T-shaped portion **341**, so the sliding member **341***a* is electrically connected between the third connection terminal **323** and the fourth connection terminal **323***a*. The AC power flows from the external power source to the second input terminal **112** of the converter **110** via the third connection terminal **323**. Then, the converter **110** converts the AC power to the DC power. In the embodiment, the logic high signal and the logic low signal are output by the electronic device **20**.

Referring to FIG. **4**, when the electronic device **20** is fully charged, the first control terminal **344** receives the logic low signal, and the second control terminal **345** receives the logic high signal, so the current flows through the second control terminal **345** and the third control terminal **346**. Under this condition, the second electromagnetic portion **343** attracts the sliding member **341***a*, so the sliding member **341** is electrically disconnected from the third connection terminal **323**. Thus, the converter **110** stops receiving the AC power.

When the electronic device **20** is disconnected from the power output unit **300**, the detection bar **325** is rebounded out of the shell **310** by the elastic member **327**, and the rotation bar **326** rotates about the pivot **329**. Thus, the first connection terminal **321** is moved away from the second connection terminal **322**, and the sliding member **341***a* is slid toward the third connection terminal **323**. Thus, the power output unit **300** is reset to the state shown in FIG. **2**.

FIGS. **5** and **6** show an internal structure of a second embodiment of a power output unit **400**. The power output unit **400** is substantially similar to the power output unit **300**, except that the power output unit **400** only includes a first switch **420**. A third connection terminal **423** is always electrically connected to a fourth connection terminal **424**.

FIGS. **7** and **8** show an internal structure of a third embodiment of a power output unit **500**. The power output unit **500** is substantially similar to the power output unit **300**, except that the power output unit **500** includes a second switch **540**, a first connection terminal **521**, a second connection terminal **522**, a third connection terminal **523**, and a fourth connection termi-

nal **524**. The second switch **540** is substantially the same as the second switch **340**. The first connection terminal **521** is fixed on the second connection terminal **522**.

When the power output unit **500** is disconnected from the electronic device **20**, or the electronic device **20** is fully charged as shown in FIG. **7**, a first control terminal **544** receives a logic low signal or is floated, a second control terminal **545** receives a logic high signal, and a current flows through the second control terminal **545**, a second electromagnetic portion **543**, and a third control terminal **546**. Under this condition, the second electromagnetic portion **543** attracts an attracting member **541***b*. Thus, the third connection terminal **523** is disconnected from a sliding member **541***a*, and the converter **110** stops working.

Referring to FIG. **8**, when the charging device **10** is used to charge the electronic device **20**, the first control terminal **544** receives a logic high signal, and the second control terminal **545** receives a logic low signal. Under this condition, a current flows through the first electromagnetic portion **542**, so the first electromagnetic portion attracts the attracting member **541***b*. Thus, the sliding member **541***a* is electrically connected between the third connection terminal **523** and the fourth connection terminal **524**. The AC power flows to the second input terminal **112** of the converter **110** via the third connection terminal **523**, and the AC power is converted to the DC power.

In summary, when the electronic device **20** is fully charged or the electronic device **20** is disconnected from the charging device **300**, the charging device **300** stops receiving the AC power. Therefore, energy is prevented from being wasted.

It is to be understood that even though numerous characteristics and advantages of the present embodiments have been set forth in the foregoing description, with details of the structures and functions of the embodiments, the disclosure is illustrative only; and changes may be in detail, especially in the matters of arrangement of parts within the principles of the embodiments to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A charging device, comprising:

a power converting unit comprising a first conductive pin, a second conductive pin, and a converter, wherein when the first conductive pin and the second conductive pin are electrically connected to an alternating current (AC) power, the converter converts the AC power to a direct current (DC) power and outputs the DC power; and

a power output unit electrically connected to the converter and outputting the DC power to an electronic device, the power output unit comprising a first switch and a shell, the first switch comprising a detection bar, a rotation bar, and a elastic member;

wherein the rotation bar rotatably fixed on the shell via a pivot, a first end of the rotation bar is connected to the shell via an elastic member, a first end of the detection bar protrudes out the shell, and a second end of the detection bar resists a second end of the rotation bar;

wherein the converter comprises a first input terminal and a second input terminal, the first input terminal is electrically connected to the first conductive pin, the second input terminal is selectively and electrically connected to or disconnected from the second conductive pin under control of the power output unit.

2. The charging device of claim **1**, wherein the first switch comprises a first connection terminal and a second connection terminal, the first connection terminal is electrically connected to the second conductive pin, the second connection terminal is electrically connected to the second input terminal.

3. The charging device of claim **2**, wherein a plurality of electrical pins are electrically connected to the converter via the plurality of cables, and the shell forms a receiving space to receive the plurality of electrical pins.

4. The charging device of claim **1**, wherein the detection bar detects whether the electronic device is electrically connected to the power output unit, and when the electronic device is electrically connected to the power output unit, the detection bar is pushed into the shell by the electronic device, when the electronic device is disconnected from the power output unit, the detection bar is rebound out of the shell by the elastic member.

5. The charging device of claim **1**, wherein the first switch further comprises a supporting portion located on the shell to limit a rotation angle of the rotation bar.

6. The charging device of claim **1**, wherein power output unit further comprises a third connection terminal and a fourth connection terminal, the fourth connection terminal is electrically connected to the second connection terminal and the third connection terminal.

7. The charging device of claim **6**, wherein the first switch further comprises a platform, and the third connection terminal and the fourth connection terminal are located on a same surface of the platform.

8. The charging device of claim **7**, wherein the power output unit further comprises a second switch, the second switch comprises a substantially T-shaped portion, a first electromagnetic portion, and a second electromagnetic portion, when a current flows through the first electromagnetic portion and the second electromagnetic portion, the first electromagnetic portion or the second electromagnetic portion is magnetized and attract the T-shaped portion.

9. The charging device of claim **8**, wherein the T-shaped portion comprises a sliding member and an attracting member, the sliding member is slidably connected to the platform and capable of sliding on the platform; the attracting member is located between the first electromagnetic portion and the second electromagnetic portion and capable of sliding along with the sliding member, when the attracting member is attracted by the first electromagnetic portion, the sliding member is electrically connected to the third connection terminal and the fourth connection terminal simultaneously, thus an electrical connection is built between the third connection terminal and the fourth connection terminal; when the attracting member is attracted by the second electromagnetic portion, the attracting member is electrically connected with the fourth connection terminal, the sliding member cut off the electrical connection between the third connection terminal and the fourth connection terminal.

10. The charging device of claim **9**, wherein the power output unit further comprises a detection control portion, which comprises a first control terminal, a second control terminal, and a third control terminal; the first control terminal and the third control terminal are electrically connected to the first electromagnetic portion, the second control terminal and the third control terminal are electrically connected to the second electromagnetic portion.

11. A charging device, comprising:

a power converting unit comprising a first conductive pin, a second conductive pin, and a converter, wherein the first conductive pin and the second conductive pin are electrically connected to an alternating current (AC) power, the converter converts the AC power to a direct current (DC) power and outputs the DC power; and

a power output unit electrically connected to the converter via a plurality of cables and outputting the DC power to an electronic device, the power output unit comprising a first switch and a shell, the first switch comprising a detection bar, a rotation bar, and a elastic member;

wherein the rotation bar rotatably fixed on the shell via a pivot, a first end of the rotation bar is connected to the shell via an elastic member, a first end of the detection bar protrudes out the shell, and a second end of the detection bar resists a second end of the rotation bar;

wherein when the electronic device is fully charged or the electronic device disconnected from the power output unit, the converter stops receiving the AC power.

12. The charging device of claim **11**, wherein the converter comprises a first input terminal and a second input terminal, the first input terminal is electrically connected to the first conductive pin, the second input terminal is electrically connected to the second conductive pin under control of the power output unit.

13. The charging device of claim **12**, wherein the first switch comprises a first connection terminal and a second connection terminal, the first connection terminal is electrically connected to the second conductive pin, the second connection terminal is electrically connected to the second input terminal.

14. The charging device of claim **13**, wherein a plurality of electrical pins are electrically connected to the converter via the plurality of cables, and the shell forms a receiving space to receive the plurality of electrical pins.

15. The charging device of claim **11**, wherein the detection bar detects whether the electronic device is electrically connected to the power output unit, and when the electronic device is electrically connected to the power output unit, the detection bar is pressed into the shell by the electronic device, when the electronic device is disconnected from the power output unit, the detection bar is rebound out the shell by the elastic member.

16. The charging device of claim **11**, wherein power output unit further comprises a third connection terminal and a fourth connection terminal, the fourth connection terminal is electrically connected to the second connection terminal and the third connection terminal.

17. The charging device of claim **11**, wherein the first switch further comprises a platform, and the third connection terminal and the fourth connection terminal are located on a same surface of the platform.

18. The charging device of claim **11**, wherein the power output unit further comprises a second switch, the second switch comprises a T-shaped portion, a first electromagnetic portion, and a second electromagnetic portion, when a current flows through the first electromagnetic portion and the second electromagnetic portion, the first electromagnetic portion or the second electromagnetic portion is magnetized and attract the T-shaped portion.

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